Original Articles

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Cellulite grading assessment in women following three different diets

Avaliação do grau de celulite em mulheres em uso de três diferentes dietas

ABSTRACT

Introduction: Although cellulite has been related to being overweight and having unhealthy eating habits, normal weight patients can also present with cellulite.
Objective: To assess the effects of three different diets in the reduction of cellulite grading in normal weight women.
Methods: Forty-three women were randomized into 3 groups: Group 1 followed a low-carbohydrate diet; Group 2, a high protein content diet; and Group 3, a control diet with standard amounts of macronutrients. Body weight for each patient was recorded and cellulite grading was assessed with the Cellulite Severity Scale.
Results: Patients in Group 2 had, on average, lower cellulite grading for the right and left gluteus compared to patients in Groups 1 and 3. Patients in Group 2 also saw a reduction in body weight and a reduction in cellulite grading on the thighs during the course of the study.
Conclusion: Patients in Group 2 had improvement in cellulite grading, possibly related to the reduction in body weight and the consequent reduction of adipose tissue. Larger studies are needed to support these data and establish the relationship between the composition of different diets and cellulite improvement.
Keywords: cellulitis; lipodystrophy, diet therapy.

RESUMO

Introdução: Embora seja conhecida a positiva relação entre o agravamento da celulite pelo excesso de peso e hábitos alimentares incorretos, pacientes com peso normal também podem apresentar celulite.
Objetivo: Avaliar o efeito de três diferentes dietas na redução do grau de celulite em mulheres com peso normal.
Métodos: Quarenta e três mulheres foram randomizadas para três diferentes grupos: o grupo 1 seguiu dieta com teor de carboidratos reduzido; o grupo 2, dieta com alto teor de proteínas; e o grupo 3, dieta-controle com quantidades normais de macronutrientes. O peso das pacientes foi aferido, e o grau de celulite foi avaliado pela escala de gravidade de celulite.
Resultados: As pacientes do grupo 2 apresentaram grau de celulite mais baixo nos glúteos direito e esquerdo em relação às pacientes dos grupos 1 e 3. Ao longo do tempo, as pacientes do grupo 2 tiveram redução no grau de celulite nas coxas.
Conclusão: As pacientes do grupo 2 apresentaram melhora no grau de celulite, provavelmente relacionada à perda de peso e consequente redução do tecido adiposo. Estudos maiores e mais abrangentes serão necessários para corroborar esse dado e estabelecer a relação entre a composição de diferentes dietas e a melhora da celulite.
Palavras-chave: celulite; lipodistrofia; dietoterapia.

INTRODUCTION

Cellulite affects nearly all women. Its prevalence is estimated at around 80-90% and although it is not considered a pathological condition, it can cause emotional distress[1,2] and is a frequent complaint on the part of patients. It occurs more frequently in the obese population, however it also affects those who are lean. It is rare in men, and in women usually starts after puberty, mainly affecting the thighs, buttocks and abdomen. [3,4] Cellulite can arise with different clinical aspects, such as those referred to as "orange peel", "cottage cheese" or "mattress appearance".

Although cellulite's pathogenesis has not yet been fully elucidated, some scientific evidence links this condition to the peculiar anatomy of women. [5,6] Among the described etiologic factors are changes in the adipose tissue [7] and the configuration of the subcutaneous connective septa.[5,6] The literature also quotes hormone and genetic [7] influences, and changes in the microcirculation. [8,9]

Alterations in the skin's relief caused by cellulite include elevated and depressed lesions. Subcutaneous fibrous septa that connect the skin to the muscle fascia produce traction on the skin, resulting in depressed lesions. [5] Elevated lesions are caused by the accumulation of fat, which causes tension within the lobe, resulting in the herniation of fat through the dermis.[7] Those herniations protrude on the cutaneous surface, producing the different appearances of the elevated lesions (orange peel, cottage cheese and mattress appearance). Nevertheless, no differences in the adipose tissue of elevated areas is observed, compared to the other areas.[10] Furthermore, sagging skin is an important aggravating factor of cellulite, especially with increasing age, and is more visible in women over 40-years-old. [4,11]

Although there is a positive correlation between cellulite and being overweight,[10] its manifestation is also common in women of normal weight and even those that are lean. However, the correlation between specific dietary patterns and the presence or worsening of cellulite is not known. It is believed that treatments aimed at losing weight can have positive effects on the appearance of cellulite, however there is still controversy about what optimal composition of diet could help to reduce the degree of cellulite.[12] The present study was aimed at evaluating the effect of a diet low in carbohydrates on reducing the degree of cellulite in women with normal weight, compared to standard diets and those with a high-protein content.

METHODS

A prospective monocentric study was conducted at the Centro Brasileiro de Estudos em Dermatologia (*Brazilian Center for Studies in Dermatology*), in the southern city of Porto Alegre, Brazil, after having been approved by the Hospital Moinhos de Vento's Research Ethics Committee. In accordance with the applicable regulations and guidelines of good clinical practice, all patients were fully informed about the study, having signed a term of informed consent before participating in the study.

Forty-three female patients aged between 18 and 40 years were included and randomized into one of three treatment groups receiving different dietary macronutrient content, with each diet having the same total caloric value. For the distribution of patients into the groups, a randomization list generated by a statistician external from the study was used. Table 1 summarizes the treatment groups according to the selected diet.

The main inclusion criteria were: body mass index (BMI) between 18.5 and 24.9 kg/m², use of effective contraception method, absence of signs of inflammatory or infectious process in the body sites studied by the evaluation, and a moderate to severe degree of cellulite in the buttocks according to the Cellulitis Severity Scale (CSS). [13]

Six follow-up visits were conducted during the study. At the screening visit, a dermatologist clinically assessed the patients and rated the degree of cellulite according to the CSS.[13] A dietitian was responsible for the nutritional assessment, as well as for the dietary guidance.

Assessed body circumferences included the waist (midpoint between the iliac crest and the lower costal margin), hip (point of maximum circumference over the buttocks) and arm (midpoint between the acromion and the olecranon), taken with a non-extensible tape measure, in centimeters and millimeters. The cutaneous folds measured were the triceps and subscapular folds. The cutoff point was parameterized using the 50th percentile, as described by Frisancho.[14] The patients' weight was measured using a scale (Welmy®, Brazil) without clothes and without shoes, while the height was measured using a wall stadiometer. The patients' diet was followed upon by the nutritionist, using the assessment tool of the standard food-questionnaire. The patients recorded their food intake for three days a week over five months – two working days (Tuesdays and Thursdays) and a weekend day (Sunday). This record served as the basis for calculating the percentage of the patients' adherence to the pro-

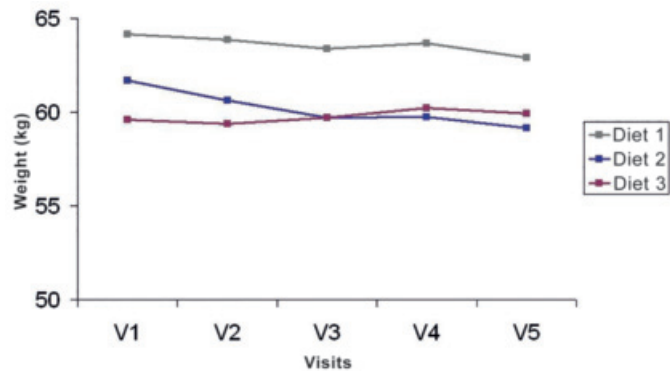| TABLE 1: Dietary treatment groups	
Groups	**Diet content**
Diet 1 (reduced carbohydrates) 15% protein 45% fat	40% carbohydrates
Diet 2 (high in protein) 22% protein 33% fat	45% carbohydrates
Diet 2 (control: normal macronutrient standards) 15% protein 25% fat	60% carbohydrates

posed diet, taking into account the percentage of ingested macronutrients versus the percentage proposed in the diet.
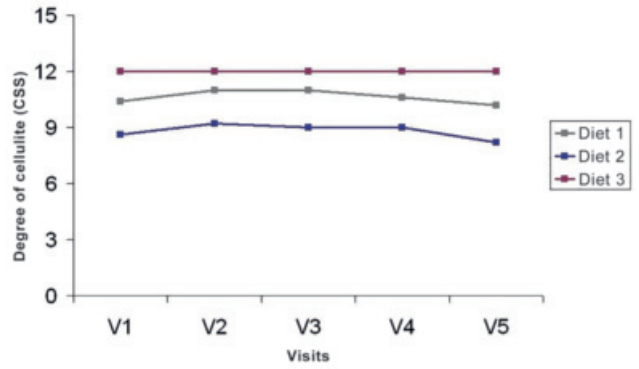
RESULTS

Nineteen of the 43 patients included (44.2%) completed the study: 5 in Group 1, 6 in Group 2, and 8 in Group 3. The demographics are described and stratified by diet in Table 2. The mean values for dietary adherence ranged between 85-89%, with no difference in adherence between groups. The average age of the patients who followed the diet with high-protein content (Diet 2) was higher when compared to that of those who followed the control diet (Diet 3) ($p = 0.04$). Other demographics were similar between diets, including weight and the degree of cellulite at baseline. Despite not being a significant aspect, the patients who followed the diet with high-protein content (Diet 2) had a lower degree of cellulite in the buttocks at baseline. That diet produced a significant decrease in weight over time ($p < 0.05$), which was not observed with the other two diets (Graph 1).

The patients who followed the diet with high-protein content (Diet 2) had lower average scores for the degree of cellulite (CSS) in the right and left buttocks, when compared to those who followed a low-carbohydrate diet (Diet 1) ($p = 0.005$ and $p = 0.051$, right and left buttocks, respectively) and the control diet (Diet 3) ($p < 0.001$ and $p = 0.007$, right and left buttocks respectively). The degree of cellulite in patients who followed Diets 1 and 2 did not differ significantly from each other in the left and right buttocks ($p = 0.080$ and $p = 0.142$, respectively). There was no improvement in the degree of cellulite in the right and left buttocks over the course of the study for any of the diet types (Graphs 2 and 3).

The patients who followed the diet with high-protein content (Diet 2) had a significantly lower degree of cellulite in the right thigh than those who followed a low-carbohydrate diet (Diet 1) in months 4 and 5, and than those who followed the control diet (Diet 3) in months 2, 4, and 5 (Graph 4). The patients who followed the diet low in carbohydrates (Diet 1) had a significantly lower degree of cellulite on the right and left thighs than those who followed the control diet (Diet 3): in month 2 for the right thigh and in months 2 and 5 for the left thigh. The group following the diet with high-protein content (Diet 2) showed an improved degree of cellulite on the right

GRAPH 2: Degree of cellulite on the right gluteus over the course of the study
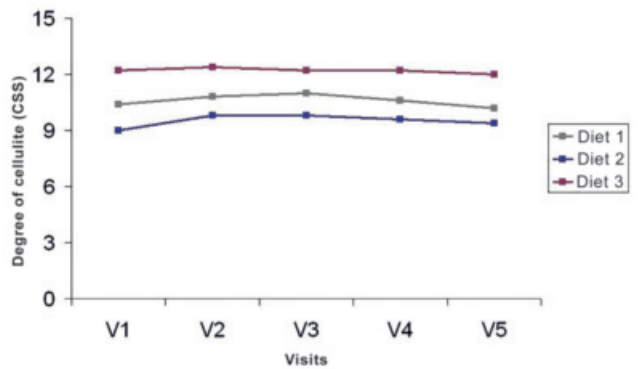
GRAPH 3: Degree of cellulite on the left gluteus over the course of the study

GRAPH 4: Degree of cellulite in the right thigh over the course of the study
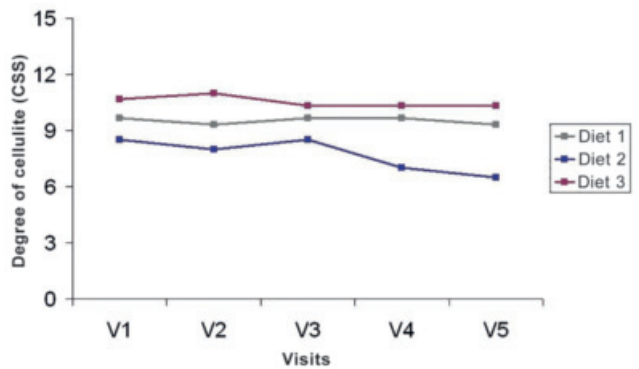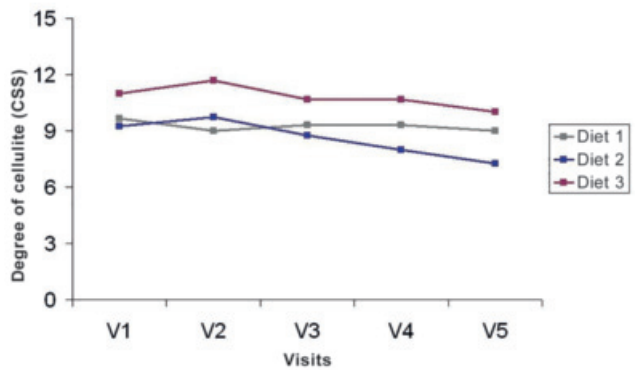

GRAPH 1: Average weight over time, diet described according to:

GRAPH 5: Degree of cellulitis in the left thigh over the course of the study

TABLE 2: Demographic characteristics of patients by group									
	Sample		**Diet 1 (n = 5)**		**Diet 2 (n = 6)**		**Diet 3 (n = 8)**		**P**
	n	**%**							
Age (years)			35a.b+8.06		39.3a+5.16		29b +7.39		0,043*
Adhesion (%)	19	(86.2)	85.9 + 9.58		87.3 + 7.94		85.4 + 4.35		0,893*
Weight (kg)	19	(61.4)	64.1 ± 8.2		61.7 ± 3.2		59.6 ± 4.7		0,364*
CSS right gluteus			10.40 ± 3.97		8.67 ± 2.52		10.7 ± 2.65		0,43
CSS left gluteus			10.40 ± 3.97		9 ± 3.16		11.13 ± 2.03		0,43
CSS right thigh			9.67 ± 1.53		8.50 ± 1.29		10.50 ± 2.07		0,26
CSS left thigh			9.67 ± 1.52		9.25 ± 2.50		10.67 ± 1.75		0,53
Marital status									0,198**
Unmarried	12	(63.2)	2	(40)	3	(50)	7	(87.5)	
Married	7	(36.8)	3	(60)	3	(50)	1	(12.5)	
Education level									0,580**
Secondary school	3	(15.8)	1	(20)	1	(16.7)	1	(12.5)	
Undergraduate	5	(26.3)	1	(20)	0	(-)	4	(50)	
Graduate	5	(26.3)	2	(40)	2	(33.3)	1	(12.5)	
Postgraduate	6	(31.6)	1	(20)	3	(50)	2	(25)	
Income									0,541**
<1 MW	1	(5.3)	0	(-)	0	(-)	1	(12.5)	
1 to 3 MW	3	(15.8)	1	(20)	1	(16.7)	1	(12,.5)	
3 to 5 MW	8	(42.1)	1	(20)	2	(33.3)	5	(62.5)	
5 to 7 MW	1	(5.3)	1	(20)	0	(-)	0	(-)	
> 7 MW	6	(31.6)	2	(40)	3	(50)	1	(1,5)	
Previous aesthetic treatment									0,509**
Yes	8	(42.1)	3	(60)	3	(50)	2	(25)	
Yes	11	(57.9)	2	(40)	3	(50)	6	(75)	
Allergy									0,432**
Yes	9	(47.4)	1	(20)	3	(50)	5	(62.5)	
Yes	10	(52.6)	4	(80)	3	(50)	3	(37.5)	
Use of medication									0,051**
Yes	8	(42.1)	4	(80)	3	(50)	1	(12.5)	
No	11	(57.9)	1	(20)	3	(50)	7	(87.5)	
Physical activity									0,509**
Yes	8	(42.1)	3	(60)	3	(50)	2	(25)	
No	11	(57.9)	2	(40)	3	(50)	6	(75)	
Children									0,265**
Yes	6	(31.6)	3	(60)	2	(33.3)	1	(12.5)	
No	13	(68.4)	2	(40)	4	(66.7)	7	(87.5)	
Smoker									
No	19	(100)	5	(100)	6	(100)	8	(100) -	
Oral contraceptive use									1**
Yes	7	(36.8)	2	(40)	2	(33.3)	3	(37.5)	
No	12	(63.2)	3	(60)	4	(66.7)	5	(62.5)	
Use of skin care products									0,434**
Yes	3	(15.8)	0	(-)	2	(33.3)	1	(12.5)	
No	16	(84.2)	5	(100)	4	(66.7)	7	(87.5)	

* Valor de p para teste Anova. As medias seguidas pela mesma letra não diferem pelo teste de significância estatística mínima. = * p-value for ANOVA. The means followed by the same letter do not differ on the minimal statistical significance test.

** Valor de p para teste exato de Fisher = ** p-value for Fisher's exact test.

thigh (p = 0.014) and left thigh (p = 0.013) throughout the entire study period (Graphs 4 and 5).

DISCUSSION

This was the first study to examine the effects of a low-carbohydrate content diet and high-protein content diet on the degree of cellulite.

The patients' adherence rate was low, considering that less than half of those who started the study (44.2%) participated up to the last proposed assessment follow-up visit. This fact demonstrates the difficulty these patients had in following a diet, regardless of the proposed diet, given that there was a high dropout rate in all groups throughout the study. In general, patients' poor adherence in studies evaluating the outcome of diets is a known fact. [15] Adherence rate is influenced by various factors, such as level of education, self-care conditions, concern with one's own quality of life, socioeconomic factors, and psychological conditions. [16,17]

The sample obtained was homogeneous regarding almost all demographics except for age, which differs between the diet Groups 2 and 3. Patients who received the diet with a high-protein content were older compared to those who received the control diet. That group's degree of cellulite, however, did not differ significantly from those of the other groups at baseline. Older patients can have a higher degree of cellulite than that of younger patients due to the sagging of skin, which tends to increase with age. [4,10,11]

It was possible to observe that patients who followed the high-protein diet showed the greatest reduction in weight when compared with those who followed other diets. In diets high in protein, 25% of the total energy intake is composed of proteins. These diets are considered effective in producing satiety due to increased dietary thermogenesis and a subsequent decrease in food intake, and can aid in weight reduction. [18]

Over time, a reduction was seen only in the degree of cellulite in the thigh, for patients who followed the diet with a high-protein content. Comparing the results of groups on each visit, it was possible to observe that these patients (Diet 2) had lower degrees of cellulite, particularly in the buttocks, when compared to patients who followed the other diets. The best effect of Diet 2 on the degree of cellulite can be related to the weight loss observed in this diet.

Lower levels of glucose, insulin, and glucagon production are attributed to the diet based on a reduced intake of carbohydrates. As a response, the body would produce oxidation of fatty acids with a corresponding result of the burning of fat stocks. [19] According to the literature, both diets low in carbohydrates and diets with reduced lipids promote weight loss. [20] Some studies [21,22] suggest that the storage of fats increases with higher concentrations of fat intake and decreases with diets low in lipid content. However, it is believed that a dietary plan low in carbohydrate content would be more effective in the long run than a diet with reduced lipid content. [20] It is possible that due to the lower thermal effect of fat and the higher energy expenditure required for the conversion of carbohydrates into fatty acids, fat is more easily stored than carbohydrates in adipose tissue. [19] Nonetheless, in the present study the diet low in carbohydrate content had no significant effect on the patients' weight or degree of cellulite.

The degree of cellulite was evaluated using the CSS, [13] a scale validated for the objective evaluation of the degree of cellulite. This scale considers the morphological components of cellulite, such as the number of visible depressed lesions, the depth of the depressed lesions, the clinical appearance of elevated lesions, sagging, and the old classification. Each of these five items is assessed with a grade scale ranging from zero to three. The sum of all items results in the final value of the degree of cellulite, which can be classified as mild (1 to 5 points), moderate (6 to 10), or severe (11 to 15 points).

The high dropout rate of patients reduced the sample considerably, affecting the power of the study. A limitation of the present study is that although the nutritional monitoring of patients has been carried out, no validated assessment tool was used to evaluate the patients' adherence to the proposed diets. The initial difference in the average age between the groups could be identified as a possible selection bias, nonetheless all inclusions were randomized.

Despite the limitations, the authors believe they have conducted an original study of a little studied topic: the different types of diet and their effect on the improvement of cellulite, a highly prevalent aesthetic condition among women. This subject deserves further analysis in light of the data from a previous study conducted in the authors' dermatological center, in which patients with nutritional bulimic behavior were found in the sample. [23]

CONCLUSION

Most of the patients studied had difficulty in following the proposed dietary regimen, regardless of the diet type. This was evidenced by the high dropout rate in the present study. The patients undergoing a diet high in protein content showed improvement in the degree of cellulite, probably related to weight loss and the resulting reduction in adipose tissue. Wider and more encompassing studies are necessary to establish the correlation between diet composition and the improvement of cellulite.

Although results are not relevant due to the small final sample, they allow for the suspicion that the reduction of body weight in patients with normal weight, independent of the specific diet type, may improve the degree of cellulite. ●

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